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DEFOLIATOR SITUATION IN THE FIR STANDS OF EASTERN OREGON AND WASHINGTON SEASON OF 1947

By

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445 U. S. Court House
Portland 5, Oregon
February 18, 1948

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DEFOLIATOR SITUATION IN THE FIR STANDS OF EASTERN OREGON AND WASHINGTON SEASON OF 1947

INTRODUCTION

Early in the spring of 1947 control of a tussock moth outbreak on the Umatilla National Forest near Troy, Oregon, was being considered. The outbreak had been discovered but not delineated in the fall of 1946; hence, information as to the extent and intensity of the outbreak was needed. The only feasible way to obtain the desired information in time to be of use was to make an aerial survey.

On March 24 and 25 an aerial survey was made in a Forest Service airplane piloted by L. J. Sohler. Buckhorn mapped the infestation and District Ranger W. W. Ward acted as observer. Delineation of the defoliated stands was difficult because of the prevalence of larch which was bare of foliage and closely resembled defoliated fir. The principal area of infestation was mapped from the air and later in the season checked on the ground. Control was undertaken on some 14,000 acres of heavily infested, merchantably valuable timber. Some 41,000 acres were excluded as being non-merchantable or too lightly infested to warrant control.

As the season progressed the tussock moth infestation in the unsprayed stands developed to a greater extent than had been anticipated. Defoliation of moderately heavy intensity became prevalent. Also, a small area of infestation was discovered some eight miles to the south, near Promise, Oregon. Reports began to come in regarding suspected centers of tussock moth infestation which proved to be outbreaks of the spruce budworm.

These events posed several problems. Information as to the regional extent and status of tussock moth infestation was needed in order to determine whether artificial control would be necessary in 1948. Extensive defoliation by the spruce budworm complicated the detection of outbreaks by the tussock moth. Furthermore, the budworm situation itself was in need of clarification, both as to the location of affected stands and the amount of damage being done.

In order to obtain the needed information, it was decided to make an aerial survey of the 7,755,000 timbered acres of the Blue Mountain region, and to make supplementary ground surveys in the Blue Mountains and elsewhere. Most of the survey work for the year was done in August and September, but information regarding the defoliator outbreaks was collected intermittently during the entire period from March to October.

The aerial survey was the most comprehensive ever made in this region (See Table 1). It was a cooperative undertaking by the Forest Service and the Bureau of Entomology and Plant Quarantine. On the area covered it provided the basic information regarding the extent of infestation. It also provided valuable information regarding the usefulness of this type of survey for detecting insect-caused losses in general. This latter phase of the aerial survey will be covered separately in a report dealing with procedures. It may be stated here that aerial surveys are a definite step forward in the detection of forest insect outbreaks. They also make ground surveys more effective by directing them to critical areas without loss of time and effort.

The ground surveys were likewise conducted cooperatively by the Forest Service and the Bureau of Entomology and Plant Quarantine. On August 21 the Office of Timber Management called upon all forest supervisors in Region 6 to check upon the defoliator situation with special reference to the Douglas-fir tussock moth and the spruce budworm. By September 8 reports were received from all the National forests. In most cases maps showing the location of outbreaks were attached. These reports provided much valuable information. It would be very helpful if similar reports could be prepared annually hereafter.

In the Blue Mountain region Buckhorn visited all of the large areas and most of the small areas spotted from the air. It is noteworthy that all known centers of infestation were detected in the aerial survey. Furthermore, many centers not previously known to exist were discovered from the air. Quite likely some areas of light defoliation were missed, but it seems significant that none such was discovered on the ground.

On the Chelan Furniss checked several of the areas reported by the Forest Service. Elsewhere the information provided by the forest officers is used as presented. In view of the findings in the Blue Mountains, it seems likely that a comprehensive aerial survey of all forest areas in the region would reveal considerably more infestation than is now known to exist.

In Table 2 the known acreage of defoliator infestation in east-side fir stands is summarized by National Forests. The individual centers of infestation are plotted on the three maps at the end of this report (Scale: 1 inch equals 12 miles). In the body of the report the situation is discussed by areas under the two principal insects that are involved.

DOUGLAS-FIR TUSSOCK MOTH (HEMEROCAMPA PSEUDOTSUGATA)

History

The Douglas-fir tussock moth is a native pest of major importance in the interior fir stands of the Pacific Northwest. In 1927 it appeared in numbers on the Colville National Forest. By 1930, when the outbreak subsided, some 300,000,000 board feet of commercial timber was killed. In the following three years a serious outbreak of Douglas-fir beetle developed in the weakened trees and added materially to the destruction.

Two relatively minor outbreaks of undetermined duration, one on the Minam Division of the Whitman and one in the vicinity of Bear Valley on the Malheur, subsided in 1929. Considerable timber was killed on the Whitman. Damage on the Malheur was largely confined to top killing.

In 1937 an outbreak was discovered on Rudio Mountain on the Malheur. It subsided in 1939 after having killed considerable timber on an over-all area of 6 x 20 miles. Near Spray on the Umatilla a similar but less severe outbreak subsided in 1940.

Situation by Forests

In this section only those forests definitely known to have harbored tussock moth infestation in 1947 are discussed.

Chelan National Forest: On July 25, 1947, Mr. Elmon Howard of the Chelan staff submitted a sample of defoliated Douglas-fir from the Twisp Ranger District. Examination revealed cocoons of the Douglas-fir tussock moth. On August 12 Howard and Furniss examined the area from which the sample was taken. They found a subsiding outbreak of the tussock moth along Newby Creek, Poorman Creek, and Alder Creek in the vicinity of Twisp. Some 6,400 acres were involved in varying degree.

The origin of this outbreak is not known, but the prevalence of old cocoons made it certain that there was heavy infestation in 1946, and possibly earlier. It is probable that considerable mortality and top killing will result from the defoliation that has occurred to date. The Newby Creek and Poorman Creek drainages have been most heavily hit. Fortunately the timber is of comparatively low value.

The known areas of tussock moth infestation on the Chelan are now under control. The principal controlling factor was a polyhedral virus disease that decimated the population in the fall of 1947 just as the pupae were forming. Parasites, principally tachinids, contributed materially to the decline. No artificial control will be needed in 1948.

Malheur National Forest: Two small centers of infestation covering a total of some 1120 acres are present on the southwestern part of the forest. The larger area of approximately 640 acres is south of Gold Hill. The smaller area of some 480 acres is near the head of Sawtooth Creek. These two centers are far removed from the principal areas of infestation in the Blue Mountain region.

Little damage has occurred in the Malheur centers, but from the large number of eggs deposited in the fall of 1947 some increase can be expected in 1948. Since the affected stands contain relatively little fir, and that of low value, the threatened increase of tussock moth infestation is not considered serious enough to warrant control. The two infested areas on the Malheur are of special interest in that they may afford an opportunity for study of the tussock moth at a time when the populations elsewhere are at low ebb.

Umatilla National Forest: Five centers of tussock moth infestation, the largest of which covers some 60,000 acres, are on the Umatilla National Forest near Troy, Oregon. It was on the eastern part of this large area that the current outbreak was detected in 1946 and where the principal loss of timber has occurred.

Wholesale destruction of timber in the largest center was prevented by the application of artificial control measures during the period June 24 to July 1. Treatment was confined to 14,000 acres of merchantably valuable timber heavily infested and immediately threatened by the tussock moth. Unmerchantable and lightly infested stands were excluded on the basis that the values were too low or the degree of infestation was insufficient to warrant expenditures for control. Protection of specific stands in 1947 was the aim. On the basis of past experience it was assumed that natural control would soon take over.

The treated area was sprayed as a phase of the North Idaho control project with a C-47 airplane carrying 1000 gallons of spray per trip and operating from Moscow, Idaho, 65 miles distant. The spray was a solution of DDT in fuel oil applied at the rate of one pound in one gallon per acre.

The results were phenomenal with practically 100 percent control resulting. However, the spraying could not be done early enough to prevent considerable tree killing on some 1000 acres where defoliation was especially heavy in 1946. This mortality was supplemented by the Douglas-fir beetle which killed many of the weakened trees that might otherwise have recovered. As the season progressed, feeding by the tussock moth larvae on unsprayed areas became very pronounced and was in marked contrast to the sprayed area where feeding ceased almost immediately after the spraying.

On the unsprayed areas a polyhedral virus disease appeared near the end of the feeding period and caused widespread mortality among the mature larvae and pupae. In some instances the disease together with parasites virtually wiped out the tussock moth population. This was the case on the four small areas to the north and east of Troy. Although disease and parasites caused a marked reduction in the tussock moth population on the unsprayed western part of the large area, a sizeable number of eggs was laid in the fall. In view of this it is anticipated that some defoliation will occur in 1948. This, coupled with the moderately heavy defoliation in 1947, may result in some tree mortality. No artificial control will be necessary since the outbreak is declining naturally, and much of the timber involved is too low in value to warrant control.

Wallowa National Forest: Three centers of tussock moth infestation covering 1500, 800, and 200 acres respectively are on private land outside the National Forest boundary near Promise, Oregon. The largest of these three was reported by the State Forester's staff early in July. The two smaller ones were discovered during the aerial survey later in the season.

On July 15 some 320 acres of the most heavily infested portion of the largest area were sprayed in a joint undertaking by the State Forester's office and the U. S. Forest Service. DDT was applied at the rate of one pound in one gallon of fuel oil and xylene per acre. No appreciable reduction of the tussock moth population was obtained. Why this should have been is not known with certainty. It is known that large larvae of the tussock moth are more resistant to DDT than are small larvae. This is believed to have been a factor contributing to the failure of the project. From the experimental standpoint, the project was highly worth while in emphasizing the importance of early application of the spray.

Late in the season the polyhedral virus disease and parasites that were so effective on the Chelan and Umatilla attacked the tussock moth on the area near Promise where spraying was done. These natural control factors reduced the tussock moth population to the vanishing point. On the two smaller areas infestation was light throughout the season and evidences of disease were nil. Numerous eggs were deposited in the fall of 1947. This may indicate an increase of infestation in 1948, but, with the general trend downward, it is probable that the two small centers will soon follow suit. Developments will be studied this coming season.

SPRUCE BUDWORM (ARCHIPS FUMIFERANA)

History

Until the current outbreak developed there was no record of any extensive infestation or appreciable damage by the spruce budworm in Oregon or Washington. This seems remarkable in view of the well established role of the budworm as a destructive pest in the fir forests of the East and the Rocky Mountain Region. For what it may be worth, the record of past outbreaks in Oregon and Washington is as follows:

1929: Keen found the budworm stripping the new foliage from Douglas-fir and western larch in the vicinity of Northport, Washington. It is assumed that the outbreak subsided without causing damage of any consequence.

1931: Beal observed light to moderate defoliation of Douglas-fir, white fir, and western larch in the forest south of Mitchell, Oregon. This outbreak too seemed to subside without causing appreciable damage.

1941 - 1942: In 1941 the Forest Service reported an infestation of white fir and lodgepole pine in the Warner Mountains south of Lakeview, Oregon. Examinations in 1941 and 1942 by Buckhorn revealed moderate defoliation. In 1942 it seemed likely that some top killing would result. What actually happened is not on record.

1943 - 1947: An outbreak in the Methow River drainage on the Chelan National Forest was reported in 1943 by the Forest Service. This outbreak has continued to develop until now it is present and active on many parts of the forest. So far no serious damage has been caused.

1944 - 1947: During the course of the regional survey in 1944 a light infestation was found on the Heppner District of the Umatilla National Forest. Since then the budworm has become active on all forests of the Blue Mountains. Currently some 710,000 acres are infested, more than half of which are on the Umatilla.

1945 - 1947: During the insect survey of 1945 a variety of the spruce budworm (Archips fumiferana retiniana) was found defoliating young ponderosa pine on the Ochoco and Malheur National Forests. At the time of discovery it was evident that the outbreak had been in progress a year or more. In 1947 the outbreak declined after having caused considerable malformation among the more heavily attacked trees.

Situation by Forests

In this section the principal emphasis is upon the Blue Mountain region which was surveyed in detail and which supports the bulk of the infestation. Other areas were not covered from the air. Concerning them the information regarding the spruce budworm infestation is sketchy at best.

Chelan National Forest: In August 1943 the Forest Supervisor reported a defoliator outbreak on Douglas-fir on the Winthrop Ranger District. Insect specimens were determined as the spruce budworm. No detailed examination was made during the war, but the forest officers reported that the outbreak continued to develop and expand. In 1945 and 1946 it was especially active along Salmon Creek and in various parts of the Methow and Twisp River drainages.

In the fall of 1947 the Forest Service reported ten areas of various sizes as being infested by defoliators, presumably the budworm. The two largest blocks, one along Twisp River and one north of Conconully, were checked by Furniss. Infestation by the spruce budworm was verified. The other areas remain to be checked in 1948.

The infestation on the Chelan, second in extent only to that on the Umatilla, has been going along at a relatively low level. So far as is known, no appreciable killing has occurred. Along Salmon Creek, where defoliation has been sustained and relatively heavy, considerable top killing and possibly some tree killing can be expected. The weakened condition of the Douglas-fir trees in the various centers is an open invitation to Douglas-fir beetle attacks. Fortunately no barkbeetle outbreak has yet developed.

Fremont National Forest: The only information regarding the situation on the Fremont is contained in the supervisor's report of September 5, 1947, as follows: "All districts report scattered infestations of the spruce budworm which is attacking white fir terminals, but the areas shown on the map are those where nearly all of the trees have been affected. This white fir infestation has hit in areas which we had in mind for Christmas tree sales, but the tips of all branches are dead for about three inches back."

The extensive outbreak on the Fremont calls for a detailed evaluation of the situation. A survey with that objective will be made in 1948.

Malheur National Forest: There are two main centers of spruce budworm infestation on the Malheur, both of which are in the northwestern part of the forest. The larger area covers some 35,000 acres and extends along the north side of the ridge from the vicinity of Black Butte to Rudio Mountain. The smaller area of some 6000 acres is on the ridge north of Fox Valley. A third and much smaller area occurs in a narrow stringer of scattered fir type on private land along Rudio Creek.

The first evidence of spruce budworm infestation on the Malheur was detected during the aerial survey of 1947. Defoliation was generally light. No tree mortality is anticipated from the feeding that has occurred to date.

Heavy defoliation was noted from the air on some 20 acres in an inaccessible area high on Fields Peak. The insect responsible for this isolated spot of infestation is not known.

In 1947 only a trace remained of the outbreak of the pine budworm (Archips fumiferana retiniana), a variety of the spruce budworm, which extensively attacked the twigs and terminals of immature ponderosa pine over a large area near Antelope Mountain. This outbreak was discovered in 1945 but evidently developed a year or more earlier. It subsided without causing damage, except for excessive branching of the more heavily infested trees. The cause of the decline of the outbreak was undetermined.

Ochoco National Forest: The aerial survey revealed some 15,000 acres of spruce budworm infestation in two centers on the Snow Mountain District. The larger area is on the western slope of Snow Mountain. The smaller area extends from a short distance south of Allison Ranger Station to Delintment Lake. The defoliation that has occurred to date is comparatively light and is not expected to cause any tree killing.

Snoqualmie National Forest: Information regarding the defoliators on the Snoqualmie is confined to the supervisor's report of September 5, 1947, as follows: "Sporadic attacks of the spruce budworm and the Douglas-fir tussock moth have been noted on our two east-side districts. However, these attacks have been of a minor nature and are not considered serious. There has been no appreciable damage to white fir or Douglas-fir as a result of insect work."

As yet this report has not been checked, but it would appear that one or both of the insects mentioned is present in incipient outbreak form. The situation warrants a thorough survey in 1948.

Umatilla National Forest: Spruce budworm infestations, both large and small, occur over the length and breadth of this forest. In all there are some 374,000 acres of infestation in 14 main centers plus a number of narrow stringers in lateral drainages of the John Day River.

The most severe defoliation by the budworm anywhere in the region is on parts of the 62,000 acre center near Dale in the Meadow Creek-Desolation Creek drainages. No doubt these stands will suffer considerable mortality for many trees on large areas have been completely stripped of foliage.

From Dale the infestation meanders westward through the scattered stands in the breaks of the North Fork of the John Day River to link up with the Wall Creek center, which is the largest in the region. It comprises 160,000 acres covering the width of the timber belt and extending from Swale Creek on the east to the Spray-Heppner highway on the west. It was on this area that the first evidence of the budworm outbreak was noted in 1944. So far the damage has not been particularly severe. The heaviest defoliation has occurred on Tamarack Mountain where some loss of timber is expected.

A small center of heavy defoliation along U. S. highway 395 at Battle Mountain State Park attracted considerable public attention in 1947. Continuation of the outbreak in and around the park will probably result in considerable tree killing and a corresponding reduction in recreational value of the park.

The largest center on the northern half of the forest covers some 67,000 acres embracing the headwaters of the Umatilla River, Phillips Creek, and Willow Creek drainages. Numerous spots of complete defoliation that will likely result in considerable loss of timber are present on this large area. Similar conditions prevail on several of the smaller areas in the northern part of the Umatilla.

The outbreak on the Umatilla generally has reached the critical stage. Continued defoliation on the areas of heavy infestation undoubtedly will result in a serious loss of timber. Plans should be readied for possible salvage operations. Direct control is, as yet, not feasible.

Wallowa National Forest: The second largest area of spruce budworm infestation in the Blue Mountains covers some 127,000 acres in the Chesnimnus drainage in the northern part of the Wallowa. Two small centers, one along Cow Creek and one near Day Ridge Guard Station, also occur in the northern part of the forest. Ten small centers are scattered in the canyons and along the lower slopes of the Wallowa Mountains. Total infested acreage for the forest amounts to 150,000 acres.

The heaviest defoliation is on the largest area but is not yet sufficient to cause much tree mortality. Some killing may occur in a few small canyons. An active outbreak of the Douglas-fir beetle is present in the Chesnimnus drainage. It is of special significance in that the bark beetles are likely to invade the trees that are weakened by the spruce budworm. This threat will become more acute in case the budworm outbreak continues.

Wenatchee National Forest: On the infestation map submitted by the supervisor on September 4, 1947, seven small spots of defoliator infestation were indicated. The defoliation in each case was reported to involve only a few immature trees.

A detailed survey is planned for 1948 in order to check upon the possibility of a developing outbreak.

Whitman National Forest: Four main centers of budworm infestation covering approximately 43,000 acres are present on the Blue Mountain Division of the forest south and west of Starkey. The heaviest defoliation, which may result in some tree mortality, occurred in the Fly Creek and Grande Ronde River canyons.

One large center of spruce budworm infestation is present on the Minam Division of the forest. It embraces some 87,000 acres in the Catherine and Mill Creek drainages. Heavy defoliation is largely confined to the eastern slope of Clark Mountain. There it is probable that some trees will die from the defoliation that has already occurred.

A defoliation of some 640 acres was s potted from the air in a rough isolated area near the head of North Pine Creek some four miles west of Homestead. The responsible insect was not determined.

SUMMARY AND DISCUSSION

An outbreak of the Douglas-fir tussock moth was discovered in 1946 on the Umatilla National Forest near Troy, Oregon. In the spring of 1947 a combined aerial and ground survey revealed an estimated 55,000 acres of infestation. Some 14,000 acres were considered to warrant artificial control.

During the period June 24 to July 1 control was applied to the 14,000 acres as one phase of the North Idaho pontrol project. Financing was by the Forest Service and the State Forester's office. DDT was used at the rate of one pound in one gallon of fuel oil per acre. Nearly perfect control was obtained. On some 1000 acres considerable tree killing developed in trees that were heavily defoliated in 1946. Much of this killing was caused by Douglas-fir beetle attacks upon the weakened trees.

On July 15 some 320 acres of tussock moth infestation near Promise, Oregon, were treated without success. The reason for this failure is not known.

A comprehensive aerial and ground survey of the Blue Mountain region during the summer and fall revealed 70,620 acres of tussock moth infestation on or adjacent to National Forests, as follows: 67,000 acres on the Umatilla, 2,500 acres on the Wallowa, and 1,120 acres on the Malheur. Ground checking disclosed 6,400 acres of tussock moth infestation on the Chelan National Forest.

Late in the season a polyhedral virus disease caused widespread killing of the tussock moth on all major areas of infestation. The disease was augmented by parasites, especially tachinids. These natural control factors have been so effective that no artificial control will be necessary in 1948.

Since 1943 on the Chelan National Forest and 1944 on the Umatilla National Forest an outbreak of the spruce budworm has been developing. In 1947 the outbreak became a major one with approximately 1,000,000 acres of known infestation. Of this, 710,000 acres are in the Blue Mountains with the Umatilla most heavily hit.

So far the damage done by the spruce budworm has been nominal. Beginning with the defoliation of 1947 it is expected that considerable tree killing will occur. Continuation of the outbreak is practically certain to cause extensive loss of timber.

Whether the present outbreak will continue to develop, can only be surmised. In the New England states, in Eastern Canada, and in the Rocky Mountain region of the United States and Canada outbreaks of the budworm have extended over periods of many years. In contrast the few outbreaks on record in Oregon and Washington have been of short duration and have caused little damage. Under the circumstances the only safe conclusion is that there is a distinct possibility that the outbreak will continue. Unfortunately no proven measures for artificial control are yet available. For the present the only feasible course is to await development and to be ready to initiate salvage operations if the need arises.

RECOMMENDATIONS

1. No artificial control of the tussock moth is recommended for 1948.

2. Further biological studies of the tussock moth are proposed in order to determine the role of natural control factors in the declining phases of an outbreak.

3. No artificial control of the spruce budworm is recommended for 1948.

4. A study of the spruce budworm with special reference to its effects upon fir stands in Oregon and Washington is suggested.

5. A comprehensive survey of the defoliator situation throughout the region is recommended along the lines developed in 1947. Extension of the aerial survey to other areas is desirable and will be undertaken, funds permitting.

6. It is recommended that all foresters be on the alert for evidences of defoliator and other insect activity and that outbreaks, however small, be promptly reported.

TABLE NO. 1

SUMMARY OF SURVEY FLIGHTS

Season of 1947

Date	Airplane	Average Speed Mi/Hr.	No. Hours	Area Covered
Mar. 24-25	Stinson Voyager	90	3:50	Umatilla
May 6	Ercoupe	85	1:00	Umatilla
Aug. 19	N3N-3	80	6:15	Umatilla Wallowa
Aug. 21	N3N-3	80	3:25	Umatilla Whitman
Aug. 23	N3N-3	80	4:25	Wallowa Whitman
Aug. 24	N3N-3	80	3:30	Umatilla Whitman
Sept. 8	Stinson Voyager	90	2:50	Umatilla Malheur
Sept. 9	Stinson Voyager	90	2:30	Malheur
Sept. 10	Stinson Voyager	90	4:25	Malheur Whitman
Sept. 11	Stinson Voyager	90	3:30	Ochoco
Total			35:40	

TABLE NO. 2

SUMMARY OF DEFOLIATOR SITUATION IN FIR STANDS OF EASTERN OREGON AND WASHINGTON - SEASON OF 1947

National Forest *	Infested Acreage: Spruce budworm	Infested Acreage: Douglas-fir tussock moth
Blue Mountain Region		
Malheur	41,000	1,120
Ochoco	15,000	
Umatilla	374,000	67,000
Wallowa	150,000	2,500
Whitman	130,000	
Subtotal	710,000	70,620
Northern Washington		
Chelan	197,600	6,400
Southern Oregon		
Fremont	79,200	
TOTAL	986,800	77,020

* Includes adjoining lands in other ownerships.

AREAS OF DEFOLIATION

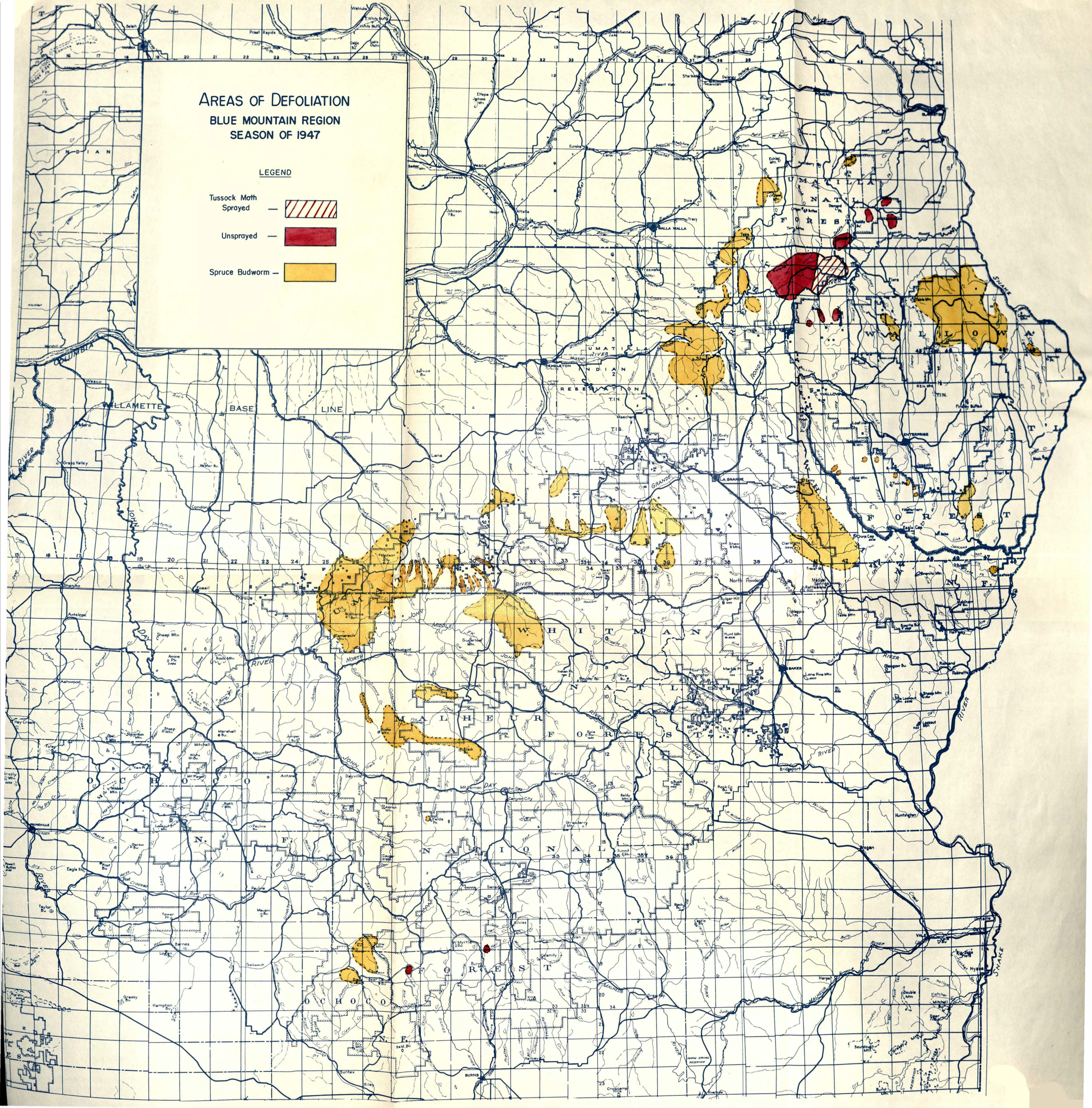
BLUE MOUNTAIN REGION
SEASON OF 1947

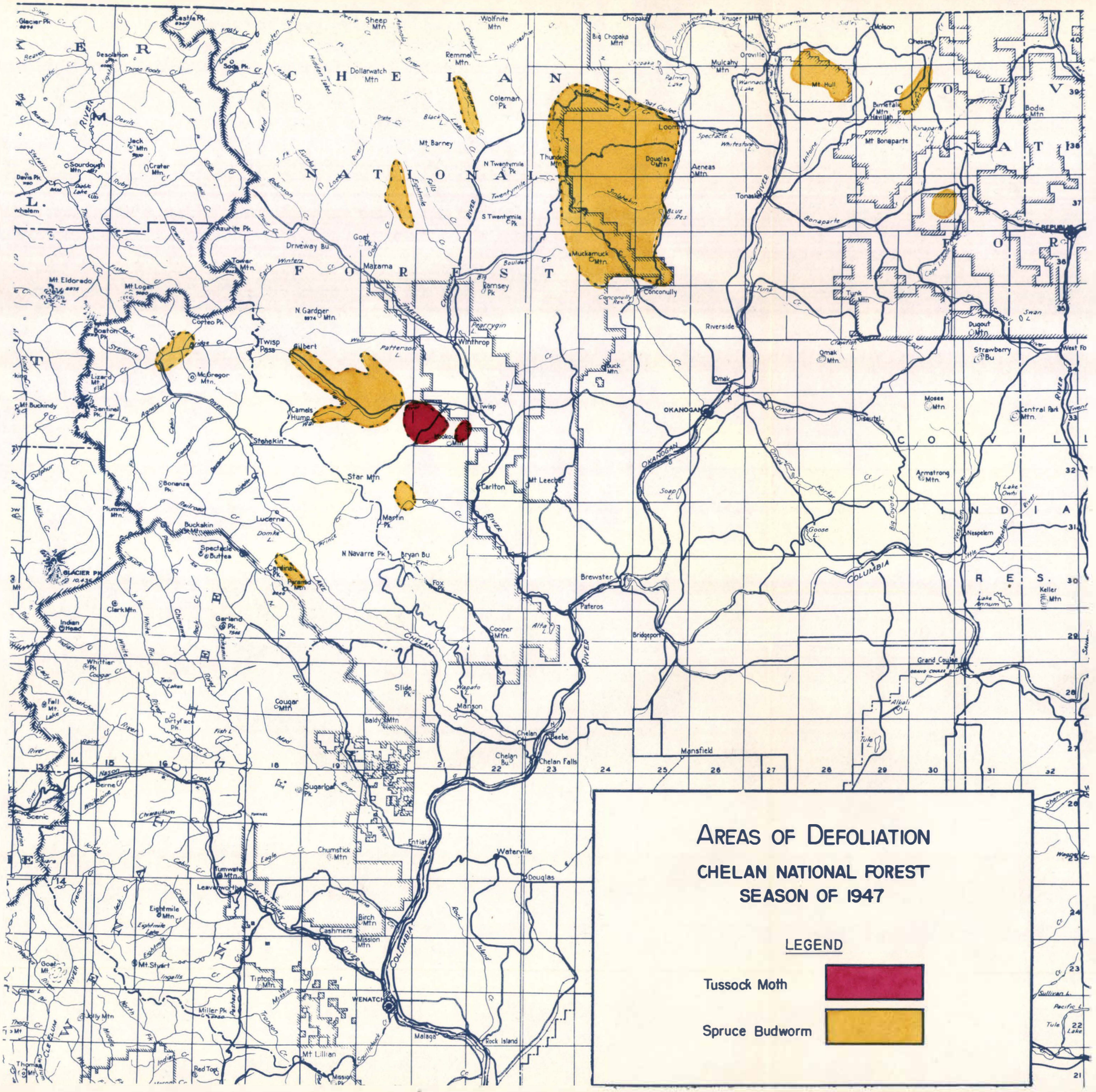
LEGEND

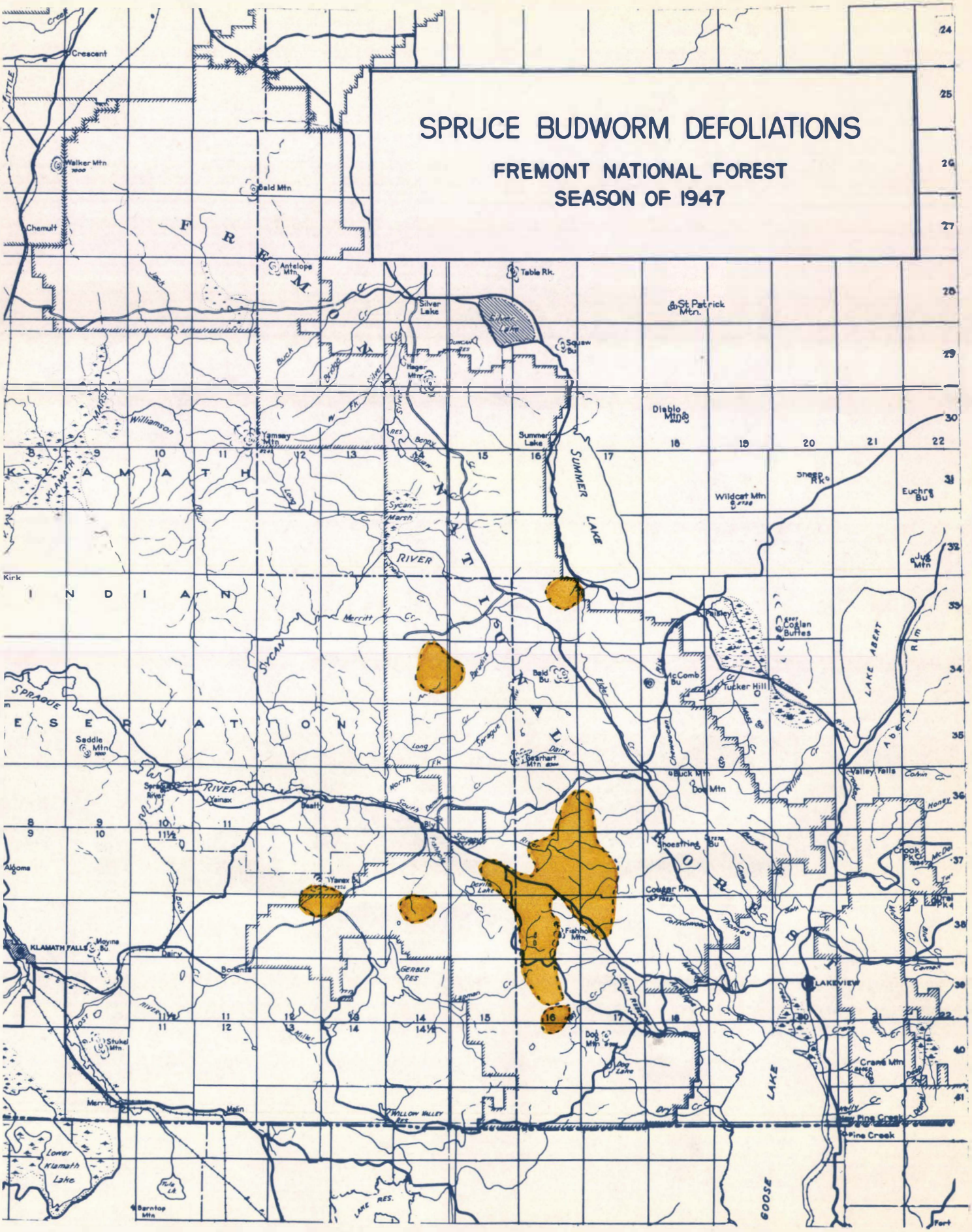
Tussock Moth Sprayed —

Unsprayed —

Spruce Budworm —




AREAS OF DEFOLIATION
CHELAN NATIONAL FOREST
SEASON OF 1947
LEGEND
Tussock Moth
Spruce Budworm
CHELAN NATIONAL FOREST
OKANOGAN NATIONAL FOREST
COLVILLE INDIAN RES.
REPUBLIC
OKANOGAN
Twisp
Winthrop
Conconully
Omak
Riverside
Brewster
Pateros
Bridgeport
Chelan
Manson
Wenatchee
Waterville
Douglas
Mansfield
Grand Coulee
Stehekin
Lucerne
Entiat
Cashmere
Leavenworth
Tumwater Mtn.
Sugarloaf Pk.
Chumstick Mtn.
Mission Mtn.
Tiptop Mtn.
Mt. Lillian
Malaga
Rock Island
Chelan Falls
Beebe
Alkali L.
Tule L.
Columbia River
Okanogan River
Methow River
Chewuch River
Twisp River
Lake Chelan
Lake Omak
Lake Osoyoos
Lake Roosevelt
Lake Annum
Soap L.
Fish L.
Goose L.
Palmer Lake
Wannacut Lake
Spectacle L.
Whitestone L.
Blue Res.
Pearrygin L.
Patterson L.
Swan L.
Sullivan L.
Pacific L.
Wapato L.
Mt. Hull
Mt. Bonaparte
Douglas Mtn.
Muckamuck Mtn.
Thunder Mtn.
Aeneas Mtn.
Tunk Mtn.
Dugout Mtn.
Strawberry Bu.
Omak Mtn.
Buck Mtn.
Moses Mtn.
Armstrong Mtn.
Central Park Mtn.
Keller Mtn.
Nespelem
Disautel
Bonaparte
Loomis
Molson
Oroville
Chesaw
Bodie Mtn.
Big Chopaka Mtn.
Chopaka
Mulcahy Mtn.
Kruger Mtn.
Similkameen
Nicomen
Sidley
Binnetalic Mtn.
Havillah
Aeneas Mtn.
Tonasket
Conconully Res.
Tunk
Cape Horn
Duck
Mt. Barney
Remmel Mtn.
Coleman Pk.
Wolfnite Mtn.
Sheep Mtn.
Dollarwatch Mtn.
Castle Pk.
Glacier Pk.
Desolation
Three Fools
Jack Mtn.
Sourdough Mtn.
Crater Mtn.
Davis Pk.
Azurite Pk.
Driveway Bu.
Goat Pk.
Mazama
Tower Mtn.
Mt. Eldorado
Mt. Logan
Boston Pk.
Corteo Pk.
N. Gardner Mtn.
Ramsey Pk.
Twisp Pass
Gilbert
McGregor Mtn.
Lizard Mtn.
Mt. Buckindy
Sentinel Pk.
Camels Hump Mtn.
Lookout Mtn.
Star Mtn.
Carlton
Mt. Leecher
Martin Pk.
Bonanza Pk.
Plummer Mtn.
Buckskin Mtn.
Spectacle Buttes
Bridal Veil Pk.
Pyramid Mtn.
N. Navarre Pk.
Bryan Bu.
Fox Pk.
Glacier Pk. 10,436
Clark Mtn.
Indian Head
Garland Pk.
Whittier Pk.
Fall Mt.
Dirtyface Pk.
Slide Pk.
Cougar Mtn.
Baldy Mtn.
Cooper Mtn.
Sugarloaf Pk.
Eightmile Mtn.
Goat Mt.
Mt. Stuart
Ingalls
Miller Pk.
Jolly Mtn.
Thomas Mtn.
Red Top Pk.
Eagle Cr.
Chiwaukum
Scenic
Berne
Leavenworth
Tumwater
Eightmile
Cashmere
Birch Mtn.
Entiat
Waterville
Douglas
Mansfield
Grand Coulee
Alkali L.
Tule L.
Sullivan L.
Pacific L.
Lake Owhi
Lake Annum
Keller Mtn.
Nespelem
Armstrong Mtn.
Central Park Mtn.
Moses Mtn.
Disautel
Omak
Okanogan
Riverside
Conconully
Winthrop
Twisp
Stehekin
Chelan
Wenatchee
Entiat
Waterville
Douglas
Mansfield
Grand Coulee
Brewster
Pateros
Bridgeport
Omak
Okanogan
Twisp
Winthrop
Conconully
Riverside
Stehekin
Chelan
Wenatchee
Entiat
Waterville
Douglas
Mansfield
Grand Coulee
Brewster
Pateros
Bridgeport


SPRUCE BUDWORM DEFOLIATIONS
FREMONT NATIONAL FOREST
SEASON OF 1947
Crescent
Walker Mtn
Bald Mtn
Chemult
Antelope Mtn.
Table Rk.
Silver Lake
St Patrick Mtn.
Diablo Mtn
Summer Lake
Wildcat Mtn
Sheep Rk.
Williamson
Yamsey Mtn
Sycan Marsh
Sycan River
Merritt Cr.
Kirk
Coglan Buttes
Lake Abert
McComb Bu
Tucker Hill
Saddle Mtn
Sprague River
Yainax
Beatty
Bearhart Mtn
Buck Mtn
Dog Mtn
Valley Falls
Shoestring
Cougar Pk.
Fishhole Mtn.
Crook Pk.
Klamath Falls
Moyina Bu
Dairy
Bonanza
Gerber Res.
Lakeview
Stukel Mtn
Merrill
Main
Willow Valley Res.
Dog Mtn
Dog Lake
Crane Mtn
Pine Creek
Lower Klamath Lake
Barntop Mtn
Lake Res.
Goose Lake